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FEVER.

Bind cover in front,

BY

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## IV.

## BLACK VOMIT OF YELLOW FEVER.

BY

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THE following observations upon the black vomit of yellow fever, are the results of labors commenced in 1856, and pursued in various portions of the Southern States up to the present time.

During the active stages of yellow fever profound changes take place in the organs and tissues, and especially in the kidneys, heart, and liver; and *oil* and *granular* albuminoid and fibroid matters transude through the capillaries and fill up the cells and excretory ducts, and arrest the functions of these organs.

The liver of yellow fever does not present the soft, friable condition characteristic of true fatty degeneration. The jaundice resulting from the suppression of the excretory function of the liver, or from the reabsorption of the bile, would appear to be due to the same causes which induce the suppression of urine, viz., to the deposits of oil and granular albuminous or fibrinous matter in the excretory structures of the kidneys and liver.

The heart in yellow fever appears to be as fully permeated with oil as the liver; in the latter organ, however, a large amount of oil is enclosed within the liver-cells.

Yellow fever is not only attended with what may be called "acute fatty degeneration," but also with such profound alterations of the fibrinous element of the blood, as to permit the transudation of the altered fibrin and albumen into the excretory tubes.

The ejection of altered blood (black vomit) from the mucous membrane of the stomach, during the period of calm or depression, although not absolutely characteristic of yellow fever—as it may occur in other diseases—is still of such frequent occurrence in yellow fever as to demand the most careful consideration, both as to its nature and origin.

The character of the matters vomited, during the progress of yellow fever, varies in different stages of the disease, and with the char-

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acter, relative mildness and severity, and the progress of the changes in the blood and organs.

Whilst yellow fever is characterized, in common with several other diseased states, by an irritation of the gastric mucous membrane, the peculiar nature of the vomited matters does not rest entirely upon the congestion and irritation of the mucous membrane of the stomach, but is influenced, to a greater or less extent, by the changes of the blood, liver, kidneys, and nervous system.

The vomiting in yellow fever may also be regarded as, to a certain extent, salutary, and as an effort for the elimination of certain excrementitious materials from the blood. In some cases, the first effect of the black vomit may seem to be salutary; the tongue improves in appearance, the febrile heat abates, and if it were not for other profound changes in the blood, liver and kidneys, lying back, as it were, of this almost universally fatal symptom, beneficial results of the most important character might flow from the relief afforded by the removal of a certain amount of excrementitious matter from the blood, as urea and ammonia.

The first ejections of the stomach of a yellow-fever patient consist, most generally, of the ordinary secretions and contents of the stomach; then follow vomiting of a mucoid fluid, frequently, at first, tinged with bile, the reaction of which varies in different cases, being alkaline in some and acid in others.

After the first vomiting, the stomach may remain tolerably quiet until the subsidence of the fever, on the third or fourth day, when, without any premonitory symptoms of nausea, the stomach, on any trifling provocation, may eject a quantity of clear, pale, almost limpid, and slightly acid, opalescent fluid. At this period the disease may terminate, or make no further progress, as if this elimination was similar to the perspiration of intermittent fever, the whole ailment vanishing at this stage.

If the vomiting continues, and passes on to black vomit, it becomes first streaked with dark flocculi of altered blood; the reaction, in many cases, changes from the acid to the alkaline; and careful chemical examinations have convinced me that this change in the reaction of the black vomit was due to the elimination, by the gastric mucous membrane, of urea, by its conversion into ammonia.

The acid reaction of the yellow-fever vomit is due, not to the presence of any peculiar acid, but to several; as the phoric (existing in the form of acid phosphates), lactic, acetic and hydrochloric acids. The degree of the acidity will also vary with the character of the fluids and solids taken into the stomach: thus, if much sugar be taken, the vomited matters will be much more strongly acid, and the pres-

ence of this substance will also determine, to a great extent, the presence and development of certain fungi, as the yeast-plant.

The rapid generation of *torulæ*, as well as the effervescence of the black vomit, is, in certain cases, referable chiefly to the presence of sugar in the aliment, and in the tea and coffee drank.

The specific gravity of black vomit, as determined by weighing with the specific-gravity bottle, varies from near the standard of distilled water to that of blood.

It is now fully admitted that black vomit is not entirely confined to yellow fever, and that it is chiefly the secretion of the mucous membrane of the stomach, and the matters introduced from without, as food, mingled with the blood, which oozes into this viscus, from the mucous surface of the stomach, denuded of epithelium and intensely congested.

But, in most cases, black vomit is something more. It is, to a certain extent, an excrementitious product, containing urea and carbonate of ammonia.

The kidneys are more or less affected in every case of yellow fever. When these organs act continuously and freely, the blood is purified of bile and urea, and black vomit more rarely occurs than in those cases in which their functions are arrested, and the mucous membrane of the stomach assumes the excretory function.

Black vomit is due to several causes :—

1st. To the direct irritation and structural alteration of the gastric mucous membrane, by the poison of yellow fever. This poison, most probably, is received into the blood and acts in this manner, or through this medium, upon the gastric mucous membrane, for we find contemporaneous changes taking place in the heart, liver and kidneys ; and these changes would most probably *succeed* to the gastric irritation, if the poison was received in food or drink, primarily, by the stomach.

2d. To the structural alterations of the blood, and especially to the marked diminution of the fibrous elements, which, as I have shown by chemical analysis of the blood of yellow fever, sinks to a lower figure than in any other known disease. It is well known that the diminution of the fibrine of the blood, below a certain standard of health, so deranges the capillary circulation, as to lead to congestion, alteration of nutrition, and secretion and passive hemorrhages. The hemorrhages and effusions of scurvy can only be referred with reason to the changes of the blood, and especially to the diminution of fibrine.

3d. To suppression of the action of the kidneys and the retention in the blood of urea and other excrementitious products, and the



elimination of urea and carbonate of ammonia, and ammonia, by the gastro-intestinal mucous membrane.

4th. To the direct irritant action of the ammonia, and excrementitious materials, eliminated vicariously, upon the mucous membrane of the stomach and intestines.

Bernard and Frerichs long since explained by experiments what we observe in these cases of yellow fever, attended with urinary suppression.

Thus the former experimenter found that a dog, which had a fistulous opening in the stomach, passed daily with his urine about 93 grains of urea and uric acid, and yet during the succeeding twenty-four hours, after the removal of the kidneys, the blood drawn from the animal exhibited only a mere trace of these constituents, but urea in abundance was detected in the gastric juice, withdrawn through the fistula; and after remaining for some time in the stomach and intestine, the urea changed into ammoniacal salts; and the gastric juice was secreted continuously, and not, as in the normal condition, only after a meal.

Not only was the manner of formation and chemical constitution of the secretion of gastric juice altered by this vicarious excretion of the main constituents of the urine, but the mucous membrane was structurally altered and became disqualified, not only for the performance of this elimination, but also for the elaboration of its normal secretion.

In yellow fever the suppression of the action of the kidneys follows immediately after, or may even commence in the midst of a devastating fever, attended with rapid alteration and chemical change of the elements of the blood, and the formation of large amounts of urea and other excrementitious matters, and the work suddenly thrown upon the already weakened and altered stomach is far greater than when the kidneys cease their action suddenly from mechanical injuries, or from sudden congestion, caused by cold, in health.

Bidder and Schmidt have shown that the digestive powers of the gastric juice are weakened, if it be mixed with any considerable quantity of saliva, in consequence, as they suppose, of the neutralization of the free acid by the alkali of the saliva; and they also found that the addition of bile to the normal gastric juice entirely suspended its digestive property, although the mixture still exhibited an acid reaction.

Bernard, Bidder and Schmidt found that gastric juice, secreted with urea, sooner or later not only became alkaline, but also lost its power of converting albumen and albuminous matters into assimilable

forms ; and Lehmann also found that the digestive power of the gastric juice was much impaired by the addition of alkaline salts, or by saturating the fluid with peptones or other organic substances, either nitrogenous or non-nitrogenous.

In yellow fever, when there is an impairment or suppression of the function of the kidneys, we not only have a combination of these various causes, producing derangement of the gastric juice, but we also have the destruction of the fibrine of the blood, inducing passive hemorrhages from the congested and altered gastric mucous membranes, and at the same time such an elevation of temperature as is most favorable to the rapid decomposition of the contents of the enfeebled stomach and intestines.

5th. To the irritant and nauseating effects of the bile retained in the blood.

The bile retained in the blood without doubt produces its characteristic effects upon the nerves supplying the stomach, inducing nausea and vomiting.

6th. To the degeneration of the excretory and secretory cells of the gastro-intestinal mucous membrane, attended with or characterized by the deposit of granular, fibrous or albuminous matter, and oil-globules in the secretory cells, and in the walls of the smaller blood-vessels and capillaries.

7th. To the capillary congestion of the gastro-intestinal mucous membrane, similar in all respects to the intense capillary congestion which characterizes all the organs and tissues in this fever.

The chief causes of black vomit therefore are :—the direct irritation of the gastric mucous membrane ; intense capillary congestion, in consequence of the morbid action of the poison of yellow fever and its products upon the vaso-motor system of nerves ; suppression of the functions of the liver and kidneys, and the retention in the blood of bile and urea, and the elimination of urea from the gastric mucous membrane, as such, in the state of ammonia and carbonate of ammonia ; and the direct irritant and solvent effects of ammonia and carbonate of ammonia upon the gastro-intestinal mucous membrane, and the effects of the urea, ammonia, and other constituents of the metamorphosis of the tissues upon the blood ; the alterations of this fluid by the changes excited by the yellow-fever poison, and the destruction and alteration of the fibrous elements.

When careful sections of the kidneys were made with Valentin's knife, and examined under the microscope, the Malpighian corpuscles and tubuli uriniferi were filled with oil-globules and granular nitrogenized matter, which appeared to be the result of the changes and modifications of the albumen and fibrine of the blood.



The excretory cells of the kidneys also contained oil-globules and granular matter.

The poison of yellow fever appears to act in an analogous manner to the agents producing small-pox, or the poison of certain reptiles, which alter the constitution of the blood, and lead to the formation of altered albuminous and fibrous products from the blood, and which, in the case of yellow fever, transude into the hepatic ducts and urinary tubes, and thus cause suppression of the urinary and biliary secretions.

When in any case of yellow fever the function of the kidneys is arrested, a fatal result necessarily ensues, not only from the retention of the urinary constituents, but also from the retention of the bile.

As long as the kidneys perform their normal function, the retained bile will be continuously eliminated; but as soon as these organs cease to act, the bile, as well as the urinary excretion, is retained in the blood, and certain nervous disturbances are induced, as dulness of the intellect, uræmic convulsions, and, in some cases, violent agitation of the muscles, resembling tetanic spasms.

Black vomit, therefore, is an *effect* or *result* of preceding actions or changes, and is not a *cause*; it is an error, therefore, to search, either by chemical means or by the microscope, for the *cause* of the disease in one of its *products*.

Black vomit, from its great amount in some cases, may be possibly a cause of death; but it is in all cases only secondary to the preceding changes in the liver, kidneys and blood, and in some cases at least in which it is the result of an effort on the part of the organism to eliminate certain materials from the blood, it may, to a certain extent, be even salutary.











# ARCHIVES

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